PB81-109480

Endrin
Position Document 4

(U.S.) Environmental Protection Agency
Arlington, VA

3 May 79

U.S. Department of Commerce
National Technical Information Service
NTIS.

50272-101

REPORT DOCUMENTATION PAGE	1. REPORT NO. EPA/SPRD -80/39	2.	3. Recipient's Accession No. PB81 109480

4. Title and Subtitle

Endrin: Position Document 4

5. Report Date 5/3/79

6.

7. Author(s)

8. Performing Organization Rept. No.

9. Performing Organization Name and Address

Special Pesticide Review Division
Environmental Protection Agency
Crystal Mall #2
Arlington, VA 22202

10. Project/Task/Work Unit No.

11. Contract(C) or Grant(G) No.

(C)

(G)

12. Sponsoring Organization Name and Address

Environmental Protection Agnecy
401 M St. S.W.
Washington, D.C. 20460

13. Type of Report & Period Covered

14.

15. Supplementary Notes

16. Abstract (Limit: 200 words)

Agency Regulatory Decision on Registration of Pesticide: Also contains comments from USDA and Scientific Advisory Panel and EPA's response to these concerns on economic, agricultural, environmental and health impact of the regulatory decision.

17. Document Analysis a. Descriptors

0504,0606,0703

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

18. Availability Statement: Unlimited	19. Security Class (This Report) Unclassified	21. No. of Pages
	20. Security Class (This Page) Unclassified	22. Price

(See ANSI-Z39.18) *See Instructions on Reverse*

OPTIONAL FORM 272 (4-77)
(Formerly NTIS-35)
Department of Commerce

PB81-109480

MAY - 3 1979

ENDRIN
POSITION DOCUMENT 4

Special Pesticide Review Division
Office of Pesticide Programs
Office of Toxic Substances
U.S. Environmental Protection Agency

EPA/SPRD - 80/39

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U.S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA 22161

Acknowledgements

Writing Staff

Kyle R. Barbehenn, Project Manager, SPRD, OPP

EPA Project Support Team

Mitchell Bernstein, Attorney, OGC
William Burnam, Pharmacologist, HED, OPP
David Coppage, Aquatic Biologist, HED, OPP
George Ludvik, Entomologist, BFSD, OPP
David Severn, Chemist, HED, OPP

EPA Pesticide Chemical Review Committee (PCRC)

Dr. William A. Wells, Chairperson, SPRD, OPP
Dr. Elizabeth L. Anderson, CAG, ORD
Dr. Richard N. Hill, OTS
Dr. Allen L. Jennings, SRD, OPM
Dr. Donna R. Kuroda, OHEE, ORD
Mr. John J. Neylan, PED, OE
Mr. Michael S. Winer, OGC

TABLE OF CONTENTS

I. Introduction 1

II. Analysis of Comments 4

A. Comments Relating to Risk 4

1. Teratogenicity 4
2. Acute Toxicity to Wildlife 14
3. Population Reductions of Aquatic Organisms 15
4. Fatality to Endangered Species 16
5. Oncogenicity 20

B. Comments Relating to Benefits 23

1. Cotton 23
2. Small Grains 26
3. Apple Orchards 30

C. Comments Relating to Regulatory Options 31

1. Designation of Target Species in Apple Orchards 31
2. Equipment 33
3. Distance Restrictions from Aquatic Habitats 34
4. Distance Restrictions from Human Habitation 50
5. Posting of Contaminated Ponds 51
6. Teratogenic Warning 53
7. Protective Clothing for Workers 56
8. Warnings on Prophylactic Use 57
9. Enforcement 60
10. Grasshopper Control

D. Comments Relating to Procedural Matters 61

1. Availability of the Agency's Rebuttal Analysis 62
2. Initiation of New Teratology Studies 63
3. Use of Relevant Information on Risk Assessment 66
4. Development of State Programs for Use on Cotton 67

III. Conclusions 68

Bibliography 73

Appendices

A. Comments by The Scientific Advisory Panel
B. Comments by the U.S. Department of Agriculture
C. Comments by the U.S. Fish and Wildlife Service

I. Introduction

The Federal Insecticide, Fungicide, and Rodenticide Act, as amended (FIFRA) [7 U.S.C. Section 136 et seq.] regulates all pesticide products. Section 6(b) of FIFRA authorizes the Administrator of the Environmental Protection Agency ("EPA" or the "Agency") to issue a notice of intent to cancel the registration of a pesticide or to change its classification if it appears to him that the pesticide or its labeling "does not comply with the provisions of [FIFRA] or, when used in accordance with widespread and commonly recognized practice, generally causes unreasonable adverse effects on the environment."

The Agency designed the Rebuttable Presumption Against Registration (RPAR) process to gather risk and benefit information about problem pesticides and to make balanced decisions concerning them in a manner which allows all interested groups to participate. This process is set forth in 40 CFR 162.11.

On July 27, 1976, the Agency issued an RPAR notice for pesticide products containing endrin (41 FR 31316). The endrin RPAR was one of the first issued by the Agency. At the time it was issued, Agency RPAR procedures were still in a formative stage, and a detailed Position Document 1 did not accompany the endrin RPAR notice. Copies of this Document, however, were provided to all registrants and other concerned parties.

On October 20, 1978, the Agency issued Endrin: Position Document 2/3 (EPA, 1978; hereinafter called PD 2/3), and published a Notice of Determination and Availability of the Position Document in the Federal Register on November 2, 1978 (43 FR 51132). In PD 2/3 the Agency analyzed the rebuttals it received in response to the original RPAR notice, presented its analysis of both the risks and benefits associated with the uses of endrin, and proposed a decision to conclude the RPAR process.

FIFRA requires the Agency to submit notices issued pursuant to Section 6 to the Secretary of Agriculture ("Secretary" or "USDA") for comment on the impact of the proposed action on the agricultural economy [Section 6(b)] and to a Scientific Advisory Panel (SAP) for comment on the impact of the proposed action on health and the environment [Section 25(d)]. The Agency is required to submit these documents to the Secretary and the SAP at least 60 days before making the final notice effective by sending it to registrants and making it public. The Secretary and the SAP may comment in writing within 30 days of receiving the notice; the Agency is required to publish any of their comments and the Administrator's responses with publication of the final notice.

Additionally, since the RPAR notice indicated that endrin had caused fatality to an endangered species, the Agency was required by Section 7 of the Endangered Species Act of 1973 (16 U.S.C. 1531; see also 50 CFR 402, 43 FR 870) to initiate formal consultation with the U.S. Fish and Wildlife Service, U.S. Department of the Interior ("FWS"). The biological opinion submitted to the Agency by the FWS on June 8, 1978 directed the Agency to take appropriate action to reduce risks to endangered species from the use of endrin and to reinitiate formal consultation on the proposed actions (Greenwalt, 1978a). The comments of the FWS to the actions proposed in PD 2/3 were made on December 14, 1978 and in a supplementary revision on March 1, 1979 (Greenwalt, 1978b; 1979).

The Agency is not required under the statute to afford registrants and other interested persons an opportunity to comment on the bases for the proposed action while it is under review by the USDA and the SAP. However, the Agency decided that it was consistent with the purpose of the RPAR process and the Agency's overall policy of open decision-making to do so. Accordingly, PD 2/3 solicited such public comments.

The Agency has received a number of public comments in response to the November 2, 1978 Notice of Determination and the Endrin PD 2/3. Responses from the SAP, the USDA, the

FWS, Velsicol Chemical Corporation ("Velsicol"), which is the sole manufacturer of endrin in the United States, the Environmental Defense Fund (EDF), and other interested parties have been analyzed and are addressed in Section II of this document. The entire responses from the SAP, the USDA and the FWS are contained in the Appendices to this PD 4.

II. Analysis of Comments

A. Comments Relating to Risk

1. Teratogenicity

Comments have been received regarding the validity of the tests on which the Agency relied in concluding that endrin has a teratogenic potential, regarding levels of exposure that can reasonably be anticipated, and regarding a margin of safety (MOS) that can be considered as "ample". These comments and the Agency's response are:

a. Validity of the Tests

The Agency's risk analysis (PD 2/3) noted that a single exposure of 5 mg/kg endrin on the eighth day of pregnancy caused significant numbers of meningoencephaloceles in hamsters. A no-observed-effect-level (NOEL) of 1.5 mg/kg was established by this study (Chernoff et al., 1978a). Although the teratogenic studies were discussed at length in the FIFRA-SAP Meeting of October 26, 1978 (Transcript of Proceedings, hereinafter referred to as SAP, date, page) the

SAP did not make a formal comment on this issue. A consultant for Velsicol seemingly challenged the validity of the Chernoff study (Velsicol, Exh.31) but the points raised were rebutted by Chernoff et al. (1978b). Velsicol's second consultant accepted the validity of the NOEL of 1.5 mg/kg (Velsicol, Exh. 30, p. 6). Since Velsicol and its first consultant now apparently accept the validity of the established NOEL for purposes of risk assessment (Velsicol, p.38 and Exh. 61) the details of the related comments and rebuttal do not require further discussion.

b. Levels of Exposure that can be Anticipated

The Agency's exposure analysis focused on dermal exposure to bystanders and persons associated with the process of applying endrin and on the ingestion of contaminated fish. The Agency believes that dermal exposure to applicators and bystanders can be reduced adequately by requiring protective clothing, prohibiting application within specified distances from human habitation and similar measures less stringent than cancellation. Ingestion exposure, however, is of particular concern to the Agency because the contamination of fish-bearing waters by runoff is difficult to control, especially where endrin is used on cotton in areas which receive substantial rainfall.

Velsicol has challenged the validity of the Agency's estimate of potential exposure from the consumption of contaminated fish. The Agency based its risk assessment on the consumption of 250g of fish containing 1.0 ppm endrin. This level of exposure was conceived, not as a "worst case" estimate, but as a reasonable one (SAP, October 26, 1978, p.14). Velsicol did not challenge the use of 250g but contends that 0.4 ppm is the highest concentration of endrin that can be expected to occur in fish (Velsicol, p.39 and Exh. 5) and relies on the National Pesticide Monitoring Program (NPMP, Seabolt, 1978) results to support its contention.

It is true that the highest concentration of endrin in fish reported for 1977 in the NPMP was 0.4 ppm. However, the NPMP samples fish from major rivers throughout the nation without regard to sources of potential contamination. Moreover, the sampling program is not designed to determine maximum residues that might occur in fish in cropland areas. NPMP samples from Alabama, Arkansas, Louisiana, Mississippi and Tennessee were taken in major rivers where cotton is grown on only a small fraction of the drainage area; where only a small fraction of the cotton that is grown is actually treated with endrin (EPA, 1977); and without regard to actual or potential runoff episodes.

Thus, it is somewhat surprising to find endrin present at any concentrations in the fish sampled. The widespread and regular occurrence of endrin in these fish is strong evidence that endrin is likely to be present in much higher concentrations in fish more closely associated with cotton culture.

Levels of endrin in the edible portion of catfish killed by endrin may in fact exceed 4 ppm (Mount and Putnicki, 1966). Since the record establishes that many fish kills have been associated with the use of endrin, especially on cotton, it can reasonably be expected that fish-bearing waters have been contaminated with sub-lethal doses of endrin with a much greater frequency. Velsicol's consultant (Velsicol, Exh.5) has estimated that fish exposed to sub-lethal doses of endrin could accumulate as much as 2.0 ppm. Thus, the Agency's use of 1.0 ppm endrin as a concentration that could reasonably be anticipated in fish consumed by humans is on firm ground[1/].

1/ Velsicol also relies on estimates of runoff concentrations which would allegedly occur if a quarter-mile barrier strip were to be imposed to show that the resulting concentrations would be "safe" for fish and apparently for residues in the fish (Velsicol p.26; Exh. 24). As discussed more fully in Section II C 3, the Agency cannot rely upon their calculations and assumptions involved in the barrier strip model and cannot reasonably conclude that residue levels would be acceptable under that proposal.

What must be anticipated in the field is a wide range of endrin residue levels in fish that vary in the probability of occurrence -- from the infrequent but very high levels associated with dead and dying fish through all degrees of sub-lethally exposed fish. The amounts of such fish that may be consumed in a day may range widely from small (125 g) through large (250 g) to exceptional portions (500 g). Ranges in the margins of safety associated with these variables will be presented below.

c. Adequacy of the Margin of Safety (MOS)

The Agency has no rule of general applicability for determining the ampleness of the teratogenic margin of safety associated particular compounds -- each chemical is evaluated individually. In evaluating endrin the Agency noted that humans might be 50 times more sensitive to the convulsive effects of endrin than are hamsters and concluded that such a difference in sensitivity might also be true for teratogenic effects (PD 2/3, p.51). Thus, the Agency concluded that exposure levels that would give rise to an MOS of 500 or lower would be cause for concern. Both the SAP (SAP, October 26, 1979, pp.30-32) and Velsicol (Velsicol, p.40 and Exh. 32) objected to the derivation of this MOS. Informally, the SAP members indicated that an

ample MOS should be somewhere between 100 and 1000 but could arrive at no scientific method for establishing an appropriate value (SAP, October 26, 1979, pp. 28-34, 124-126). No formal recommendation was made.

Velsicol has attempted to make several points bearing on the assessment of teratogenic risk that require a clarifying response:

1) Velsicol claims that the "actual" NOEL lies somewhere between the lowest observed effect level (5 mg/kg) and the observed NOEL (1.5 mg/kg) (Velsicol, pp.41-2, Footnote (FN) 7). This contention is merely speculative. The Agency must rely on established values in estimating the MOS.

2) Velsicol argues that an MOS of 100 is appropriate for endrin. Velsicol states "As Dr. Wilson notes (Exhibit 32), and as the Agency acknowledges (Position Document 2/3, p. 51), however, a margin of safety of 100 is normally ample for low potential environmental teratogens such as pesticides..." (Velsicol, p.40). The Agency has neither characterized pesticides in general nor endrin specifically as "low potential environmental teratogens". Further, what the Agency did say concerning the adequacy of margins of safety was:

> While the Agency has not established official guidelines for determining the adequacy of the MOS for teratogens in general, Agency toxicologists believe that an MOS below 100 would be a matter of serious concern. Interpreting these values, however, requires a judgement based on other factors associated with characteristics of the chemical, routes of exposure, and the probability of various levels of exposure. Thus, the above value should not be construed as an established Agency policy but only as a toxicological guideline for risk assessment against which benefits must be balanced and additional safety requirements imposed (PD 2/3, p.50-1).

3) Velsicol's consultant, Dr. Wilson, has taken exception to the informal comments by the SAP suggesting that an MOS of 1000 might be appropriate. According to Dr. Wilson, "The only reasonable justification for a margin of safety of 1000 would be in the event that endrin were an environmental pollutant of no or negative economic importance and totally without benefit to man. To the contrary, it makes a significant contribution toward providing food and fiber to meet human needs" (Velsicol, Exh. 35). Clearly, Dr. Wilson's concept of the adequacy of an MOS is not cast solely in terms of assessing risk, per se, but is predicated on assumptions concerning environmental pollution and benefits of use. In admitting, however, that a MOS of 1000 may be justified in some circumstances,

Dr. Wilson apparently concedes that the teratogenic risk at margins of safety greater than 100 may be cause for concern[2/]. As discussed above, the Agency does take benefits into account in reaching a final regulatory decision concerning a use of a pesticide. Here, the facts that meningoencephalocele is a very serious defect and that the benefits from the use of endrin on cotton are very low lead the Agency to conclude that an MOS much greater than 100 is appropriate for this use of endrin.

4) Another of Velsicol's arguments implicitly objects to the Agency's use of any MOS at all. Velsicol contends that a pregnant woman would have to consume "ludicrously massive amounts of endrin-contaminated fish to incur a teratogenic hazard" (Velsicol, p.38). Velsicol then

---

2/ In fact, Dr. Wilson's reasoning would indicate that an MOS of between 100 and 1000 is appropriate for endrin. Endrin was found in the vast majority of the fish inhabiting all major rivers sampled by the NPMP in Alabama, Arkansas, Louisiana, Mississippi and Tennessee in 1977 (Seabolt, 1978) and it has occurred at lethal or near lethal levels in the brains of brown pelicans, white pelicans and bald eagles (PD 2/3, pp. 37-9). While endrin may not share the apparent ubiquity of certain other organochlorines in the environment, it certainly qualifies as an "environmental pollutant". Further, the value of endrin in protecting the nation's cotton crop, rather than being "significant", is marginal at best.

goes on to calculate the amount of "maximally contaminated" fish[3/] that a pregnant woman would have to consume "in order to incur the threshold teratogenic dose" (Velsicol, p.39). Presentation of the data in this fashion completely ignores the concept of providing an adequate margin of safety to prevent susceptible persons from ever receiving a "threshold teratogenic dose". The Agency must reject any approach to risk assessment which is premised on the expression of risk in terms of exposure with no margin of safety associated with it. Rather, the Agency must exercise its judgment based on the margins of safety which are afforded by the levels of exposure that can reasonably be anticipated.

The following table indicates the teratogenic margins of safety associated with various levels of consumption of contaminated fish by a 50 kg woman:

Endrin concentration (ppm)	Level of consumption (grams)		
	125	250	500
0.1	7500	3750	1870
0.5	1500	750	375
1.0	750	375	187
2.0	375	187	93
4.0	187	93	46

3/ Velsicol assumes this to be at levels of 0.4 ppm rather than 1 ppm even though the same consultant elsewhere estimates that sublethal doses may result in bioaccumulation as high as 2 ppm.

The Agency's illustration of a MOS of 375 associated with the consumption of 250 g of fish containing 1.0 ppm endrin (PD 2/3, p.58) should be put in the context of the total array of possible risk situations rather than isolated as a single point of contention. As indicated in the above table, the lowest MOS that can reasonably be anticipated (46) would result from an opportunistic harvest of fish in the final throes of endrin toxicity that are consumed in very large quantity, perhaps because refrigeration is lacking. Such a scenario can reasonably be anticipated but may not be a very common event[4/]. On the other hand, judging by NPMP data, women consuming fish caught in the major rivers of the Delta region would commonly be exposed to endrin residues but seldom at levels providing an MOS of less than 1000. Between these two extremes lies an area of intermediate teratogenic risk that is associated with the consumption of fish from many ponds and streams that are contaminated by sublethal levels of endrin because of their proximity to cotton culture. The risks from such exposure must be considered as unreasonable in light of the low benefits associated with the use of endrin on cotton.

4/ While pesticides are deliberately used to harvest fish in some parts of the world, it is more reasonable to hypothesize that adults or children may encounter fish in distress from endrin toxicity, may harvest these fish before they are dead, and that pregnant women may consume these fish.

2. Acute Toxicity to Wildlife

Velsicol (pp. 46-51) has commented at some length on the issue of acute toxicity to wildlife, emphasizing theoretical reasons why the Agency erred in presuming the existence of this risk and noting an absence of confirmatory evidence. Their major argument is that many forms of wildlife will develop an avoidance response from consuming sub-lethal levels of endrin. The Agency agrees, in principle, that, because of behavioral characteristics, certain individuals or certain species may not be susceptible to poisoning by endrin. On the other hand, the record indicates that wildlife kills have been observed from the use of endrin on wheat in Colorado (Hinkle, 1979); on cotton fields in California and Alabama, and on alfalfa in California (Bushong, 1978). It can reasonably be inferred from these incidents that the foliar application of endrin at any registered dosage has a potential for killing wildlife, despite the theorizing of Velsicol's consultant (Velsicol, Exh. 46). This conclusion is not ameliorated by self-serving allegations of lack of observed effects which are not supported by an appropriate investigation or analysis[5/].

5/ For instance, Warren Smith (Velsicol, FN 11) has reported that deer, woodchucks and rabbits continued to thrive a year after orchards in New York were treated with endrin. Deer, however, are browsers unlikely to be feeding extensively on the ground vegetation of orchards, woodchucks should all be in hibernation at the time endrin is applied, and rabbits have a high reproductive potential to compensate for
(Footnote Continued)

The Agency is not aware of adequate surveys conducted by wildlife biologists that demonstrate the absence of adverse effects on wildlife from the use of endrin.

3. Population Reduction of Aquatic Organisms

In PD 2/3 the Agency set forth the circumstances surrounding many events that led the Agency to conclude that runoff of endrin has been a major cause of the reported fish kills. Velsicol does not dispute that endrin may have caused fish kills in the past but persists in maintaining that the "reported problems arose from misapplication or misuse of endrin" (Velsicol, p.45). Velsicol's claims of misuse are purely conjectural and are insufficient to overcome the presumption of risk[6/].

Perhaps the most persuasive evidence that the lethal endrin concentrations associated with many fish kills arose from normal application practices rather than from misuse stems from the association of those incidents with

---

5/ (Con't) any excessive mortality. Mr. Smith's training is not in the area of wildlife biology and his argument reflects this lack of expertise. Moreover, the report of the monitoring study of these orchards by wildlife biologists is not yet available.

6/ Moreover, Velsicol contends that "the empirical data of sporadic fish kills relied upon by the Agency actually tend to confirm Dr. Freed's theoretical kinetics" concerning runoff potential (discussed more fully in Section II C 3, below) (Velsicol, p.23). Whether or not this is true, this argument appears to be inconsistent with Velsicol's misuse argument since Dr. Freed's theoretical kinetics are not based on misuse.

toxaphene as well. Velsicol has asserted that "Toxaphene was identified by the Agency as the causal agent in many of the very same PERS incidents which earlier had been attributed to endrin" (Velsicol, FN 12). As noted in PD 2/3 (p.22), such a coincidence does not serve to exonerate endrin. The frequent coincidence of high concentrations of both endrin and toxaphene, however, is strong circumstantial evidence that the source of both is runoff since it is highly improbable that both endrin and toxaphene were misapplied or misused independently of each other on numerous occasions at the same time and general area. The Agency continues to believe that most fish kills that have resulted from either endrin, toxaphene or both were the result of use consistent with the label. As discussed more fully below, the Agency also remains unconvinced that a 1/4 mile barrier strip will adequately reduce runoff of these pesticides.

4. Fatality to Endangered Species

At the request of the Director of the U.S. Fish and Wildlife Service (Greenwalt, 1978a) the Agency reinitiated Section 7 Consultation prior to determining what final actions to take with respect to endrin. In response, the FWS expressed the opinion, in essence, that most of the Agency's proposed regulatory actions and use restrictions alleviated the FWS' concern for adverse impacts of

endrin to threatened and endangered species (Greenwalt, 1978b). An exception made by the FWS was that the use of endrin to control orchard mice was likely to jeopardize the continued existence of the Arctic and American peregrine falcons and the bald eagle when used in the normal ranges of these birds.

At the FIFRA-SAP meeting (SAP, October 26, 1978 pp.102-3) the Agency's attention was directed to an unpublished manuscript by Stickel et al. (Undated) in which endrin was identified as the cause of death for two bald eagles. This manuscript was not previously available to the endrin RPAR record. The SAP formally recommended that the Agency address the concerns of the FWS by imposing geographical restrictions for the use of endrin in orchards (Fowler, 1978). The EDF, relying on the FWS position, proposed additional cancellation of endrin uses (Hinkle, 1979).

Following additional investigations among its staff and consultation with the Agency, however, the FWS revised its position on the use of endrin to control orchard mice, concluding in essence that a case for risk to the Arctic and American peregine falcons and to bald eagles could not be substantiated by currently available information (Greenwalt, 1979). Accordingly, the FWS concluded that the use of endrin to control voles in orchards is not

likely to jeopardize the continued existence of those species. Any new evidence, however, could require a reappraisal of the FWS' opinion.

Velsicol has made several comments on the risks to endangered species (Velsicol, pp. 54-8) that do not affect the Agency's position but which require response.

1) Velsicol states, "In view of the evidence on the Louisiana brown pelican presented by Velsicol and in view of the conclusion drawn by Director Greenwalt, the Agency has conceded that the endangered species trigger had been rebutted successfully (Position Document 2/3, pp. 33-40)". While the Position Document does in fact conclude that "the risk to endangered species has been rebutted for the brown pelican", the Agency specifically rejected all of Velsicol's arguments as the basis for such a conclusion (PD 2/3, pp.35-8). Further, the probable fatality to two bald eagles noted in PD 2/3 and the confirmed fatality of two additional bald eagles introduced to the record by the SAP are sufficient to maintain the Agency's concern for that species. However, the Agency has addressed this concern by requiring that fish killed by endrin be collected and buried, thus substantially reducing the most likely source

of exposure to bald eagles. With this new requirement, the Agency agrees that the continued use of endrin "is not likely to jeopardize the continued existence of the bald eagle" (Greenwalt, 1979).

2) Velsicol contests the conclusion of the FWS regarding the potential for secondary poisoning of raptors from birds and rabbits that may be exposed to endrin-treated orchards by citing reports submitted by Warren Smith (Velsicol, p.57, FN 11). As noted above (FN 5) however, Mr. Smith's observations on wildlife do not address the issue. The relevant document on this issue will be the report of the monitoring program conducted in New York in 1977 and this report, as indicated in PD 2/3 (pp.61-2), is not yet available because chemical analyses are incomplete.

3) Velsicol cites the opinion of Dr. Howard regarding hazards of secondary poisoning potential to falcons and eagles. However, Velsicol specifically addresses lack of hazard associated with the consumption of orchard mice (Velsicol, p.58) rather than the non-target birds and rabbits that are the concern of the FWS.

In summary, the Agency agrees with the revised position of the FWS in concluding that the available evidence does not support the conclusion that the use of endrin is

likely to jeopardize the continued existence of peregrine falcons and bald eagles and also concurs that the situation should be reevaluated as new information becomes available. Thus, the available evidence does not require changes in the Agency's position on endangered species.

5. Oncogenicity

The Agency's Carcinogen Assessment Group (CAG) analyzed the available evidence on the oncogenicity of endrin and concluded that endrin was unlikely to be a human carcinogen. Accordingly, in PD 2/3, the Agency took the position that the oncogenicity "trigger" had been rebutted. Dr. Melvin Reuber criticized the Agency's conclusion. Dr. Reuber made an oral presentation to the SAP on October 26, 1978 and submitted written comments to the SAP and to the Agency (Reuber, 1978a; b). The CAG has submitted written responses (Anderson, 1978a; b). At the December 14, 1978 SAP meeting, Dr. Reuber and Dr. Roy Albert, Chairman of the CAG, both discussed the issue of endrin's oncogenicity and responded to Panel members' questions.

Dr. Reuber's major points are (1) that most of the oncogenic studies conducted with endrin are invalid for various reasons and the negative findings reported from such studies should receive no weight in assessing the oncogenicity of endrin and (2) that certain of the studies resulted

in statistically significant increases in tumors associated with exposure to endrin. The CAG responded that some of the allegedly positive results involved differences of opinion among pathologists. For instance, Dr. Reuber's diagnosis of certain liver tumors in the FDA rat study could not be confirmed by two other consultant pathologists. Since Dr. Reuber declined an invitation to participate in a joint examination of the slides, the CAG accepted the opinion of the other pathologists. Additionally, Dr. Reuber differed with another consultant, Dr. Frith, on the relative number of malignant vs. benign mammary tumors in rats and the CAG's position was that the total tumor yield, whether or not they were classified as benign or malignant, was not related to endrin dosage (SAP, Dec.14, 1978, p.23). While the CAG acknowledged that most of the available studies had some deficiences, it also indicated that all contributed some information and it determined, on balance, that the slight indication of positive endrin effect found in the FDA rat study and the Kettering mouse study was insufficient to indicate that endrin was likely to be a human carcinogen. (For detailed discussion, see SAP, December 14, 1978).

The EDF also commented on the oncogenicity issue at the SAP meeting and in a submission to the Agency (Hinkle, 1979). The EDF argues that respectable scientific authority is sufficient evidence upon which the Agency may

rely in a determination and that such authority does not have to reflect a majority opinion. The EDF alleges that critical questions regarding the endrin studies remain unanswered and, especially in light of Dr. Reuber's diagnosis, the issue of endrin's carcinogenicity remains an open question. Dr. Albert, in response to similar questioning by the SAP, indicated that Dr. Reuber's opinions had been given a great deal of attention by the CAG (SAP, Dec.14, 1978, p. 35).

Velsicol has also submitted comments on the question of oncogenicity and the Agency must respond to certain of their statements. By incomplete quotation of the NCI Technical Report Series No. 12 (Velsicol, Exh. 48), Velsicol has incorrectly implied that the NCI conclusions were unqualified. Velsicol reported that NCI had concluded that endrin "was not carcinogenic for...rats or for...mice" (Velsicol, p.53). The full statement reads, "It is concluded that under the condition of this bioassay, endrin was not carcinogenic for Osborne-Mendel rats or for B6C3F1 mice." By removing the limitations on the conclusion, Velsicol has improperly generalized its applicability. The NCI clearly did not speak to the conclusions of other existing tests, to what might be the case in other strains of rodents, or to how differences in conditions might have affected the outcome of the NCI tests.

Velsicol's comments also incorrectly characterized both the SAP's and the Agency's positions with respect to the oncogenic status of endrin. Velsicol states, "Moreover, the Agency's Scientific Advisory Panel reviewed the evidence of record and concurred in the Agency's conclusion that endrin is not carcinogenic." (Velsicol, p.53). In fact, the SAP has made no formal comment on the issue and thus has neither concurred in nor dissented from the Agency's conclusion. Moreover, it is the Agency's position only that the weight of the evidence is that endrin is "unlikely to be a human carcinogen" (PD 2/3, p. 44); the Agency has never unqualifiedly concluded that "endrin is not carcinogenic." The Agency recognized that there was some evidence suggestive of oncogenic effects but that the evidence as a whole supported the conclusion that endrin is unlikely to be a human carcinogen. That there was insufficient evidence for the Agency to consider endrin a probable human carcinogen does not mean---as Velsicol suggests--that the Agency has made an unqualified negative finding.

B. Comments Relating to Benefits

1. Cotton

The USDA (Bergland, 1978) comments:

> "We believe the cancellation of uses on cotton in the Southeast and Delta will have limited economic impact at the present time. However, a number of entomologists in the

> cotton producing States have pointed out that the use of endrin on cotton could become critical if current alternative pesticides are lost through the regulatory process, reduced market availability, or become less effective".

In response, the Agency is pleased that the USDA concurs with the Agency's analysis of the present benefits of endrin on cotton which provides the basis for its regulatory decision. If future events indicate a substantial change in the risk/benefit picture, at that time the Agency can reconsider its regulatory decision.

Velsicol has commented extensively on the essentiality of endrin in Integrated Pest Management Programs (IPMP), especially for control of the bollworm complex, and on the economic impact of an endrin cancellation (Velsicol, pp. 60-74). Velsicol states that experts in Alabama, Arkansas, and Mississippi have presented data which indicate that bollworm resistance to endrin in those states is not currently a widespread or major problem (Velsicol, pp. 62 and 66) but that it remains effective on light to moderate infestations. Judicious use of endrin, allegedly, can retard the development of resistance to newer pesticides. Velsicol offers some recent data on treatment costs indicating that a replacement of endrin with the most likely non-RPAR pesticides would result in a total increase in costs of $1,436,116 rather than the Agency's estimate of $717,850.

The Agency's perception of the benefits from the use of endrin on cotton differs only in detail from Velsicol's. The Agency's understanding is that bollworm resistance to endrin per se is virtually complete (Lincoln, 1979; EPA, 1977) and therefore, as Velsicol indicates, endrin is currently formulated for use on cotton mainly in combination with methyl parathion. Moreover, Velsicol admits that the combination is generally efficaceous only for light to moderate infestations. While the Agency concedes that some benefits could be derived from the use of endrin on cotton, Velsicol's claim of essentiality is hardly supported by the dramatic decline in use in Mississippi, "from approximately 275,000 pounds in 1973 to approximately 75,000 pounds in 1977, and even less in 1978" (Velsicol, Exh. 18). The Agency agrees in principle that the use of a variety of pesticides may be desirable to retard the development of resistance and that endrin could theoretically continue to play some role in IPM programs. Velsicol's claims that endrin is essential for this purpose, however, are not supported by the record.

Velsicol's conclusion that a cancellation of endrin would increase costs by $1.4 million rather than the Agency's estimate of $0.72 million may well reflect current costs of pesticides more accurately than did the Agency's

analysis which was based on 1976 values. Even so, the impact projected by Velsicol is probably exaggerated for several reasons. The RPAR compounds EPN and toxaphene were not considered as viable substitutes by Velsicol. While some regulatory action may be taken on toxaphene, the RPAR on EPN has not been issued yet and, while it is too early to predict, EPN may well remain a viable substitute for endrin on cotton beyond the immediate future, thus lessening the long term economic impact of an endrin cancellation. Additionally, Velsicol's analysis fails to account for the reduction in benefits that would result from the regulatory action it would prefer, imposition of a 1/4 mile distance restriction from water (and human habitation) in the states east of Interstate Highway 35 (I-35). Even under Velsicol's analysis, however, its conclusion with regard to endrin's economic importance to the cotton growing industry is remarkably similar to the Agency's and the Agency continues to maintain that endrin is only of minor significance to the cotton industry.

2. Small Grains

The USDA (Bergland, 1978) has criticized the Agency for an alleged failure to give sufficient consideration to the possible benefits of relatively insignificant uses of endrin for which economic data may be lacking, such as the use of endrin to control chinch bugs. With respect to the

use of endrin on chinch bugs, however, public response to the proposed decision set forth in PD 2/3 indicates that the Agency was correct in attributing little or no economic value to endrin. Dr. Leroy Brooks (Kansas), the only proponent of the use, did not renew his appeal for retaining that use after the issuance of PD 2/3, although he submitted other comments to the USDA (Brooks, 1978). No other comments (including those from Velsicol) were received on chinch bugs and the USDA did not specify other uses with respect to which USDA believed the Agency incorrectly assessed the benefits of endrin.

Velsicol's comments with regard to the use of endrin on small grains contain substantial errors of fact. Regarding Kansas, Velsicol claims that 1,200,000 acres are treated with endrin (presumably for control of pale western cutworm) and, for Oklahoma, 2,000,000 acres are said to be infested and treated for army cutworm (Velsicol, pp. 76-7). These values are inconsistent with the cited references, with the Agency's estimate of usage, and with Velsicol's own production and sales figures. Regarding pale western cutworms in Kansas, Dr. Brooks stated that, "Some localized infestations requiring treatment of 10 to 20 thousand acres occur every two to three years. Large scale outbreaks ... that would necessitate treatments over a much larger

area (possibly up to a million acres) could occur..." (Velsicol, Exh. 58). Regarding Oklahoma, Dr. Coppock reported that, "Between five and six million acres of winter wheat were sprayed for the greenbug [emphasis added] and army cutworms during that time [1976] "(Coppock, 1976) and Velsicol's estimate can not be derived from that reference. The Agency's estimate for all states combined was an annual average of 416,000 acres for pale western and 691,000 acres for army cutworms. Velsicol's own production estimates indicate a range in usage on small grains from 201,000 pounds in 1976 to 25,000 pounds in 1977 (PD 2/3, p.6). At 3-4 oz. active ingredient of endrin per acre, these amounts would have treated from a maximum of one million acres in 1976 to a minimum of one hundred thousand acres in 1977. Thus, the Agency's analysis may have over-estimated the benefits of endrin's use on small grains somewhat but Velsicol's claims of treated acreage can not be remotely supported by their own production and sales figures, which were provided by Velsicol to provide a more accurate picture of recent usage.

Velsicol also notes the need for endrin to control grasshoppers on small grains but stated, "This use is not discussed herein because presently endrin is registered for use on grasshoppers only in Montana" (Velsicol, p. 75,

FN 23). The Agency noted that it had no data which could be used to evaluate the benefits from the use of endrin to control grasshoppers (PD 2/3, p. 143) and the EDF has protested that there are many available substitutes registered for grasshopper control in small grains and rangeland (Hinkle, 1979). However, endrin is not registered for use in rangeland and several of EDF's alternative pesticides are not registered for use on small grains. PD 2/3 (p. 39) incorrectly listed phorate as an alternative since it is recommended as a border treatment in Montana. To clarify the record, the only federally registered alternatives for the use of endrin on wheat are malathion, parathion, methyl parathion and toxaphene. Nosema locustae is also registered but its usefulness in the field is not well established.

Velsicol has submitted new data on the comparative efficacy of insecticides to control grasshoppers in Oklahoma (Coppock and Pitts, undated). The results of these tests indicate that malathion, parathion and toxaphene gave excellent control under the test conditions.

Velsicol has also stated, "Endrin is applied at the exceedingly low rate of 3-4 oz. a.i./acre, and this is an environmental benefit of usage" (Velsicol, p. 77). The Agency does not believe that the circumstances of dosage rates constitute an "environmental benefit" in the normal sense of that term and Velsicol's unsupported claim to that effect is rejected.

3. Apple Orchards

Velsicol's comments on the benefits of endrin's use in apple orchards contains some erroneous points critical of the Agency's Benefit Analysis (EPA, 1977). Velsicol states that the Agency inappropriately focused upon total apple acres when assessing endrin, and infers that the Agency was naive in not recognizing the "economically disastrous" effects of voles in affected orchards. Velsicol also states that the Agency's national estimates of the effect of an endrin cancellation upon apple supplies is "misleading". Further, Velsicol charges "that the Agency has attempted to minimize the vole problem". Velsicol concludes by asserting that the Agency should have limited its analysis to vole-infested orchards and should have extended the analysis beyond the three-year time horizon presented in the Benefit Analysis (Velsicol, pp.78-9).

These assertions center around two factors: 1) Velsicol is apparently unaware of the Agency's policy to analyze the effects of its intended regulations at all levels, and 2) has misunderstood the Agency's Benefit Analysis. The Benefit Analysis includes an assessment of market (domestic apple supplies and prices), consumer (retail price effects), and producer (production, farm level price, revenue, and cost changes) impacts.

The inclusion of the effect of an endrin cancellation upon national apple supplies and prices is neither "misleading" nor an "attempt to minimize the vole problem" but an Agency requirement. The Endrin Benefit Analysis for Orchards also includes an extensive discussion of producer-level impacts, including analysis of apple losses, production cost changes, farm level prices, and farm revenues. The cost-effectiveness of endrin and various alternative control strategies used by apple growers are also discussed at length. Since the effects of an endrin cancellation may extend beyond current users, the Agency was prudent in not limiting the analysis to owners of vole-infested orchards.

With regard to the three-year time horizon used in the report, the Agency is fully aware that impacts could extend beyond this period. However, available data do not permit an accurate assessment of the economic effects likely to occur in the long term (EPA, 1977 pp. 74-5, 80-1, 84-5).

C. Comments Relating to Regulatory Options

1. Designation of Target Species in Apple Orchards

The USDA (Bergland, 1978) notes, "The use of the word 'only' in identifying the vole species to be controlled in apple orchards may cause unnecessary enforcement problems when more than one species is established in

an orchard. We assume that the destruction of eastern meadow voles incidental to the control of pine voles would not be considered inconsistent with the labeling." Additionally, Dr. Don Hayne (personal communication, Nov. 14, 1978) has noted that the Agency's use of the terms "eastern" and "western" meadow voles has no basis in scientific nomenclature. Dr. Ross Byers (1978) has indicated that the prairie vole (Microtus ochrogaster) has behavioral characteristics similar to that of the pine vole and that the need for endrin to control this species in the mid-West should be investigated.

Having received no additional information, the Agency is unable to address Dr. Byers' concern. The Agency agrees with Dr. Hayne's point. Accordingly, labels for use in apple orchards should designate the pest species as follows:

Eastern United States: Pine Voles (Microtus pinetorum)
Western United States: Meadow Voles (Microtus species)

The distribution of commercial apple growing areas is such that the broad geographical limits do not pose problems of interpretation.

The USDA is correct in its assumption that the destruction of meadow voles incidental to the control of pine voles from the use of endrin in eastern orchards containing both pine voles and meadow voles would not be

inconsistent with the label. The use of the word "only" on the label is necessary, however, to preclude the use of endrin where it is intended to control meadow voles rather than pine voles in the East. The presence of pine voles in an orchard in the East may not be used as a pretext for the use of endrin intended only to control meadow voles.

2. Equipment

The USDA commented that, for aerial application, wind velocities should be stated as the maximum allowed (i.e. 10 mph) rather than as a range (i.e. 2-10 mph) and that the flying heights should be the same for all crops. Additionally, the State of North Carolina recommended that the label specify "apply only with ground equipment" for use in apple orchards (Blaylock, 1978).

In specifying a minimal wind velocity for aerial application, the Agency is following the recommendation of Velsicol's Expert Panel (Akesson, 1977) and believes that this represents sound advice for controlling drift because it is supported by empirical data and rational analyses. The variable height of application referred to by the USDA stems from a typographical error. The maximum height for aerial application should be 10 feet above all crops. While it is unlikely that anyone would attempt to control voles by treating apple orchards with endrin by air, such an attempt would be extremely hazardous. Accordingly, such application will be prohibited by a label restriction.

3. Distance Restriction from Aquatic Habitats

a. Cotton Usage East of Interstate Highway 35

The Agency concluded in the Endrin PD 2/3 that the hazard of endrin to fish arises from transport to water by both drift and runoff. It concluded that a distance restriction can substantially reduce endrin contamination of water resulting from drift, but that no information was available to assess the impact of a distance restriction on the reduction of contamination from runoff. In response to the recommended regulatory option in PD 2/3 to cancel endrin use on cotton east of Interstate Highway 35, Velsicol submitted an extensive discussion defending the efficacy of a 1/4 mile restriction from water bodies in diminishing endrin runoff to water in the southeastern United States. The Agency has already engaged in several exchanges of comments on the runoff question with Velsicol and its consultant, both prior to and during the SAP proceedings (Velsicol Exh. 21,22,23,25; Severn, 1978; SAP, October 26, 1978). The Agency will now respond to Velsicol's summary presentation of the issues which it made in its comments on Position Document 2/3 (Velsicol, pp.17-30). In Velsicol's summary, the following points were made:

(a) endrin is strongly adsorbed to soil particles at the application site;

(b) endrin has a "comparatively short residual life" in the environment;

(c) not more than 1% of applied endrin would be carried to the edge of a treated plot by an intense rainfall;

(d) an intervening 1/4 mile of bare cultivated soil would reduce runoff concentrations of endrin to 1% of this 1%, or 0.01% of the amount applied;

(e) vegetation in the barrier strip would further reduce the runoff by another factor of 10;

(f) maximum concentration in a pond containing two acre-feet of water resulting from application of 1.25 lbs of endrin to one acre separated from the pond by a barrier strip covered with vegetation would be approximately 2 ppt;

(g) the efficacy of the distance restriction has been demonstrated by the reduction in fish kills observed in Arkansas after the imposition of a distance restriction;

(h) the acceptability of the distance restriction is also demonstrated by its imposition in Mississippi as part of an emergency exemption for synthetic pyrethroid application to cotton;

(i) monitoring data from Alabama confirm the efficacy of intervening land in decreasing endrin residues in ponds;

(j) distance restrictions imposed by the United States Forest Service for pesticide applications in forest areas also support the efficacy of distance restrictions in reducing contamination of adjacent waters; and

(k) in summary, the evidence that a quarter-mile barrier would render endrin runoff from southeastern cotton fields innocuous is overwhelming, and warrants revision of the Agency's preliminary recommendation to cancel the cotton use in the Southeast.

The Agency's response will discuss each of these points in order.

(a) Adsorption of Endrin to Soil

The Agency accepts the view put forward by Velsicol that endrin may be strongly bound to soil or suspended sediment. It is generally agreed (Pionke and Chesters, 1973; USDA/EPA, 1976) that compounds which are strongly adsorbed will move mostly on sediment particles. Thus the major mode of runoff transport of endrin is probably through erosion processes.

Since endrin is applied as a foliar spray, rather than directly to the ground, a potential problem appears to be washoff from the foliage soon after application. The record of endrin-related fish kills appears to be correlated with rainfall incidents. Estimates of the amount of pesticide deposited on foliage from aerial application vary, but 50% on foliage and 50% on the ground appears to be a reasonable estimate. Sparr et al. (1966) observed a concentration of endrin in runoff water during a rainfall event seven days after application which was higher than that found during irrigation prior to the rain and stated:

> We believe that this higher endrin concentration resulted from washing the endrin off the foliage.

While there are major flaws in this study (the particulate fraction of the runoff was apparently not analyzed, although this fraction would be expected to contain most of the endrin, as noted above), the study at least suggests that foliar washoff during a rainfall event is an additional consideration in evaluating the overall extent of endrin transport by runoff.

Another study indicating that foliar washoff of pesticides from cotton makes an important contribution to runoff was recently reported by Willis et al. (1976). These

workers applied toxaphene and other pesticides to cotton in a nearly flat watershed equipped with instrumentation to measure surface runoff and sediment and chemical yields at the point where runoff entered a four-acre pond. They found a total of 0.038 lbs/acre of toxaphene in runoff during the period from August to February (a period of low sediment yield); a total of 9 lbs/acre of toxaphene had been applied in August and September. They concluded that the freshly sprayed leaves were an important source of toxaphene in runoff in August and September. These workers also observed that:

> Current cultural practices in the Mississippi Delta may be intensifying sediment and chemical transport from agricultural fields. After harvest, many farmers shred plant residues, till the soil, and form rows. The fields are left with little or no vegetative cover throughout the winter and early spring, and are subject to the erosive forces of rainfall and runoff until adequate cover develops.

Since, as noted above, endrin is bound to soil particles, this study suggests that substantial runoff transport of endrin may occur under current cotton cultural practices.

(b) Environmental Persistence of Endrin

Velsicol concluded that endrin has a comparatively short residual life in the environment. Persistence on foliage or soil is an important issue, since

the longer a chemical resides at the site of application, the more opportunity there will be for runoff events to occur. The Agency realizes that persistence is not an important factor for runoff events which occur immediately following application, but it is, of course, concerned with all runoff events occurring subsequent to application.

Velsicol cited studies on endrin photodegradation (Baker and Applegate, 1974) and soil metabolism (Castro and Yoshida, 1971; Matsumura et al., 1971) in support of its conclusions with regard to endrin persistence. The study by Baker and Applegate used blacklight lamps to irradiate thin films of endrin and other pesticides on glass in the laboratory; they reported a 10-30% photodecomposition of endrin in 20 hours, compared to dark controls. This study has little utility for evaluating the environmental photodegradation of endrin, since it presents no data on the photochemistry of soil-bound endrin. It is likely that bound endrin would be much less accessible to sunlight and in addition might be inherently less photoreactive. The artificial light source employed also makes this study less valid. The claim that mirex was photodegraded suggests that the emission spectrum of the lamps used extended to well below 290 nm (the lower limit of natural sunlight), since mirex has virtually no absorption above 250 nm and no photoreaction could be detected using natural sunlight

(Alley et al., 1974). In summary, the information presented by Baker and Applegate may not be used as a reliable indicator of the environmental photodegradation of endrin.

The soil metabolism study of Castro and Yoshida (1971) was performed in flooded and upland soils in the Philippines. Endrin was found to degrade rapidly in a flooded soil but was in fact quite persistent (88% recovered after two months) when the same soil was maintained at 80% of the maximum water-holding capacity. In any event, this study is of dubious utility in evaluating persistence of endrin in the soils of the southeastern United States. A monitoring study performed in 1966 in Greenville, Mississippi (USDA, 1968) found high residues of endrin in soil more than one year after treatment. Soybeans planted in these soils had endrin residues resulting from translocation. While the studies of Matsumura et al. (1971) showed that 25 of 150 soil cultures had the capacity to degrade endrin in laboratory culture, it is clear that endrin can be sufficiently persistent in the southeastern United States to survive a winter season.

(c) Estimates of Extent of Runoff From Treated Fields

Velsicol concluded that, as a worst case, not more than 1% of the endrin applied would be carried to the edge of a treated plot by soil erosion. In support of

this conclusion, a limited number of controlled runoff studies were cited, in which the total amount of pesticide leaving the field was measured to be less than 1%. However, two recent reviews (Pionke and Chesters, 1973; Leonard et al., 1976) have compiled a much larger number of such runoff studies; the overall range of extent of loss varied from 0.007% to approximately 40%, with 11 studies reporting losses in excess of 1%. These studies encompassed a wide range of conditions (type of pesticide and application conditions, rainfall characteristics, type of soil, crop, slope, etc.), all of which strongly influence runoff, as noted by Velsicol. In addition, a very recent study (Smith et al., 1978) used paraquat as a tracer compound for estimation of sediment transport in a Southern Piedmont watershed. When applied to the soil surface, runoff losses of paraquat commonly exceeded 5%. Although no cover crop was present in this case, it appears that sediment transport of bound pesticides can be a reasonably effective process. Precise predictions of the behavior of endrin when applied to cotton in the Southeast may not be made based on data currently available. However, based on the studies which are available, the Agency concludes that a 1% runoff yield, while reasonable some of the time, is certainly not a "worst case". If it were necessary to establish such a "worst case", 10% would probably represent an upper limit of runoff transport from treated fields for most situations.

(d) Efficiency of a Barrier Strip in Reducing Runoff

The Agency in PD 2/3 concluded that no information was available on which to base a quantitative estimate of the efficacy of intervening land in reducing the runoff potential of endrin. This conclusion derived in part from the observation that quantitative runoff studies (as discussed in (c) above) commonly measured runoff immediately adjacent to the treated field. This point was also made by Velsicol. However, the summary document submitted by Velsicol also states that:

> ...on the basis of this worst-case runoff model, Dr. Freed calculated that the quarter-mile barrier (assuming it was bare-cultivated) would reduce runoff concentrations of endrin to 1% of what they would be under similar worst-case circumstances with no barrier strip... (Velsicol, p.25)

The calculation referred to above is the use of the Universal Soil Loss Equation and a sediment delivery ratio equation to calculate the amount of chemical in overland runoff; the value computed was 0.0127 pounds. The values of the input parameters for the equations are not presented, nor is the manner of carrying out the calculation. In any event, these calculations are not based on any field experiments with endrin, despite Velsicol's contention that detailed data and other information have been provided to the Agency to evaluate endrin runoff.

There is no question but that intervening land areas can have the effect of reducing sediment runoff and thus sediment-bound pesticide transport. However, erosion continues as a major problem; for example, an annual sediment yield of 11.6 tons per acre was measured on nearly flat land in the Mississippi Delta (Willis et al., 1976). A general equation for the amount of sediment transported overland is apparently not available. Values of the ratio of sediment transported from a specific area by erosion to the amount received by a body of water range from about 0.1 to 0.3 (USDA/EPA, 1975). This report also concluded that:

> The sediment discharged to large rivers is usually less than one-fourth of that eroded from the land surface.

Obviously, this amount will vary with rainfall intensity and previous surface conditions, as well as the distance over which it is transported. A major runoff event may also pick up sediment deposited during prior runoff events (USDA/EPA, 1976).

In conclusion, the Agency's perception is that it is not possible to predict the extent of overland transport of endrin by erosive processes because of the variable nature of these processes and thus, the efficacy of a barrier strip in reducing endrin runoff cannot be predicted. The Agency concludes that Velsicol's contention

that a "worst case" of endrin transport across a 1/4 mile barrier strip is 1% of that leaving the treated field is not justified since it is not clearly supported by any available information.

(e) Effect of Vegetation in Attenuating Runoff

Velsicol concluded that vegetative cover on the proposed barrier strip would further reduce endrin transport by a factor of ten. An exploratory survey (Moubry et al., 1967) of endrin runoff through heavy turf in a Wisconsin orchard was cited, in which no endrin was detectable in runoff water; the water was observed to be devoid of silt. The relevance of this study to cotton runoff is questionable, since it does not appear that cotton fields generally are surrounded by heavy turf. The observations of Willis et al. (1976), quoted above, suggest that very little vegetative cover may be available throughout much of the year in cotton culture. For the cover and management factor appearing in the Universal Soil Loss Equation (USDA/EPA, 1975), a value of 0.34-0.4, corresponding to about 60% reduction in sediment yield, is a generalized value for cotton. Loss Equation (USDA/EPA, 1975). Thus, a factor of perhaps two or three, rather than ten, appears to be a reasonable estimate of the effect of vegetative cover on a barrier strip in reducing endrin runoff.

(f) Calculation of Maximum Endrin Concentration

Based on its estimates of endrin runoff from a treated plot, across a barrier strip, and through vegetation, Velsicol calculated that the maximum concentration in a two acre-foot pond located 1/4 mile away from a single treated acre would be 2 ppt. As discussed above, the Agency does not accept these three estimated runoff percentages, or, therefore, the calculated pond concentration based on them. Moreover, the use of a single acre as a plot size is particularly unreasonable; clearly, many acres of cotton could be treated in a single watershed. As noted by Leonard et al. (1976):

> The pesticide load in runoff and on sediment times the areal extent of usage is the pesticide dosage entering the receiving water.

The Agency believes that integrated sampling of a watershed area, in which all of the runoff is channeled through a flume and sampled continuously, is the only reliable way to quantitate pesticide losses in runoff. The studies by Willis et al. (1976) and Smith et al. (1978) are examples of such studies. In the absence of adequate data of this nature, the Agency can not reasonably conclude that Velsicol's calculation of maximum endrin concentration in receiving waters is supported.

(g) The Arkansas Distance Restriction

Velsicol stated that a reduction in fish kills in Arkansas following imposition of a 1/4 mile aerial application distance restriction from commercial fish ponds and hatcheries demonstrates the efficacy of such restrictions in diminishing runoff transport. Arkansas and Mississippi are areas of intensive commercial catfish farming. Crockett et al. (1975) sampled catfish from 50 farms in 1970 and reported that 76% of the fish samples contained endrin. They concluded that aerial transport of endrin from nearby cotton areas was the most probable route of contamination. They also observed that commercial fish ponds are generally constructed to prevent the entry of surface runoff. Thus it appears likely that the reason that the imposed distance restriction resulted in a decrease in fish kills, to the extent that those data are accurate and complete, was because drift was the main source of contamination of the commercial fish ponds. The Agency accordingly concludes that the alleged success of the distance restriction in Arkansas does not answer the question of reduction in runoff transport.

(h) The Emergency Exemption in Mississippi

Velsicol claimed that the imposition of a 1/4 mile distance restriction for an emergency exemption involving synthetic pyrethroids in Mississippi and the

resulting lack of fish kills demonstrates the efficacy of the restriction in diminishing runoff. A 1/4 mile restriction is commonly imposed as a condition of an emergency exemption use as a precautionary measure to reduce aquatic contamination while adequate data are being developed for registration purposes. However, the restriction is not imposed on the basis of any particular data or information regarding environmental transport or the effectiveness of a barrier strip in reducing transport. The fact that a distance restriction was invoked for an emergency exemption does not necessarily establish its efficacy as a condition of permanent registration. Additionally, Velsicol has not submitted any monitoring data to support their allegation of lack of fish kills.

(i) Alabama monitoring data

The Alabama monitoring data (Elliott, undated) reported a wide range of endrin residues in pond water, sediment, fish, soil, forage, rats and birds. Endrin treatment history was not reported, so that correlation between endrin use and resulting environmental residues is not possible. This study was not designed to evaluate the efficacy of the distance restriction in diminishing endrin residues in water, and no conclusions regarding the efficacy can be drawn from the study.

(j) Distance Restrictions in Forest Areas

The United States Forest Service employs distance restrictions for pesticide applications in forest areas. Since vegetative cover and soil surface conditions in forest areas are entirely different from those expected adjacent to southeastern cotton fields, the Agency concludes that distance restrictions used in the forest have no relevance to cotton agriculture.

(k) Summary

Velsicol stated that there is overwhelming evidence that a 1/4 mile distance restriction would render innocuous any endrin runoff from southeastern cotton fields. The Agency has reviewed all the information submitted by Velsicol concerning this issue, as well as additional information cited above. The Agency concludes that endrin transport to water by runoff would still be a substantial possibility if the distance restriction were to be imposed, and that no reliable information is available to insure that the attenuation of this transport by a barrier strip would consistently be of the order of magnitude suggested by Velsicol. Accordingly, the conclusions submitted by Velsicol on the issue of runoff cannot be considered adequate to support its proposal of allowing endrin use on cotton in the southeast subject to a 1/4 mile distance restriction from water.

Additionally, Velsicol has stated that its proposed distance restrictions from bodies of water "would reduce runoff to innocuous levels even under worst-case circumstances"; that "the Agency has acknowledged the validity of this point with respect to small grains regions and western cotton regions where heavy rainfall is infrequent ..."; and that "The Agency also agrees with Velsicol that a similar distance restriction of 50 feet is appropriate for the apple orchard use" (Velsicol, p.24). These statements totally distort the Agency's position on the effectiveness of barrier strips in reducing runoff. In all cases where the Agency has proposed that a distance restriction be imposed, the purpose was to reduce drift to acceptable levels relative to the perceived benefits of usage. In the case of orchards, at the very place cited by Velsicol (PD 2/3, p.157), the Agency stated that:

> Major risks to fish and wildlife would remain because of the high application rate to the terrestrial habitat and because the potential for runoff would be little affected by a distance restriction of 50 feet.

The Agency has never accepted Velsicol's contention with regard to barrier strips as an effective means of reducing runoff and objects to Velsicol's inaccurate representation of the record.

b. Small Grains

In response to the Agency's proposal to permit applications of endrin adjacent to ponds owned by the user, Velsicol has repeated its proposal to prohibit applications within 1/4 mile of all lakes, ponds, and streams (Velsicol, p.90). In PD 2/3 the Agency presented its rationale for excepting ponds owned by the user: as a matter of policy, the farmer should have the right to choose between risking his fish and protecting his wheat (PD 2/3, p.145). Velsicol has given no reason for denying the farmers that option, and Agency sees no reason to change its position.

Dr. Leroy Brooks (1978) has recommended that the distance restriction be reduced to 1/8 mile if endrin is applied by ground equipment. Dr. Brooks' recommendation is consistent with the intent of the regulations. Drift from a boom ground sprayer two feet above the wheat will travel less than half the distance than will the drift from an airplane at an elevation of 10 feet if both have similar nozzles and pressures. Therefore a 1/8 mile distance restriction is appropriate for such ground equipment and will be so indicated on the label.

4. Distance Restriction from Human Habitation

The SAP questioned the basis for the Agency's proposal to prohibit application of endrin within 150 yards of human habitation (SAP, Dec. 15, 1978 pp.5-6) and recommended that the distance be extended to 1/4 mile from

human habitation (Fowler, 1978). Velsicol supported the imposition of a quarter-mile restriction. The basis for the Agency's proposal, set forth in PD 2/3 (p. 128), was that the MOS for teratogenic risk estimated for a distance of 150 yards is ample (5500). Neither the SAP nor Velsicol demonstrated any deficiency in the Agency's assessment. If the MOS is ample, it would be unreasonable to restrict further the economic benefits to the user.

The Agency concedes that its risk estimate assumed compliance by the applicator regarding equipment, wind speed and other restrictions, in the absence of full compliance, the calculation of the MOS would be in error by an unknown amount. Therefore, in consideration of the recommendations of both the SAP and Velsicol and consistency in the specification of distances on labels, the Agency will compromise its position and direct that this restriction be modified to read "1/8 mile" (220 yards) instead of 150 yards.

5. Posting of Contaminated Ponds

In the event of a fish kill, the Agency proposed that the pond be posted "Contaminated: No Fishing" for a period of one year. Velsicol characterizes this warning as "inadequate" and indicates that a more appropriate warning would be as follows: "Contaminated: Use of this

Water For Drinking, Fishing, Swimming or Other Recreational Purposes Is Prohibited" (Velsicol, p.90). Velsicol's position, however, is unsupported by any analysis. A direct overspray was estimated to produce a concentration of 0.009 mg/l (9 ppb) in a pond 2 feet deep (Velsicol, Exh. 5). Were a woman to drink as much as a gallon of water containing 10 ppb endrin, the MOS would be 2000. The Agency does not consider Velsicol's concern for this risk to be well founded and will not consent to the addition of misleading warnings on labels.

Other issues concerning posting have also been raised. One is whether the duration of posting should be less than a year. Another is whether posting is necessary in situations where contamination is likely but the level is below that which kills fish. The latter issue was raised at the SAP meeting (SAP, October 26, 1978, p.121) but was left unresolved. Unfortunately, there is no ample body of field data to provide a basis for setting safety standards. It seems reasonable and prudent, therefore, to require that, if treatment is made at distances closer than 1/4 mile by air or 1/8 mile by ground from ponds owned by the user, that such ponds be posted for a period of 6 months if no fish are killed and 12 months if a fish kill occurs. In any case, fishing may be permitted if laboratory analysis indicates

that endrin concentration in the edible portion of fish do not equal or exceed 0.3 ppm (which is the current FDA Action Level for endrin residues in fish), since the MOS for a pregnant woman consuming 315 g (11 oz.) of fish contaminated at this level is 1000. These restrictions may be revised when a body of data regarding residue reduction in the field becomes available.

6. Teratogenicity Warning

The Preliminary Determination proposed that appropriate endrin labels bear a "Warning to Female Workers" that "Excessive Exposure to Endrin May Cause Birth Defects". Velsicol opposes the inclusion of such a warning on endrin labels. (Velsicol, p.88). The bases for Velsicol's opposition and the Agency's responses are:

a. The margin of safety for applicators is 300 and this is three times the acceptable level. Barring accidents and assuming that they follow label instructions, applicators and other workers are at little risk from the teratogenic effects of endrin. One of the purposes of the warning, however, is to insure that vulnerable female workers are aware of the potential risks so that they may exercise the appropriate precautions and respond properly to accidental exposure. One drop of a 19.7% EC formulation contains 10 mg of endrin and 10% absorption of that drop

provides an MOS of only 75 for teratogenic effects. Certainly such potential exposure should be of substantial concern. Further, as discussed above, the Agency does not conclude that an MOS of 100 is "acceptable" for all teratogenic risks.

b. Also, the phrase "excessive exposure to endrin may cause birth defects" is factually inaccurate because exposure to threshold teratogenic levels of endrin would cause acute toxicity or death to humans before such exposure could cause birth defects (see p. 41 of this response and Exhibit 43). The references cited do not elaborate on the above issue but only indicate that endrin may cause single convulsions in humans at dosages of 0.20 to 0.25 mg/kg and multiple convulsions at 1 mg/kg. It is the Agency's position that, since teratogenic effects in the hamster were observed at doses which did not produce convulsions or other overt signs of toxicity, the same relative relationship may exist for humans. That is, a teratogenic hazard in humans may occur before any toxic warning signs are observed. Velsicol's argument would have some validity only if terata in test animals were associated only with severe toxic effects in the dams, which is not the case with endrin. In addition, even if endrin did cause acute toxicity in humans at doses below the teratogenic threshold, the teratogenic concern would not thereby be eliminated.

c. Furthermore, any such theoretical hazard would only apply to pregnant pesticide applicators ... and only during the early months of pregnancy. The Agency agrees that only pregnant women are at risk of birth defects but the period of vulnerability has not been established. The warning should be modified to read "Excessive exposure to endrin during pregnancy may cause birth defects".

d. If a teratogenicity warning is warranted for a weak teratogen such as endrin with only a remote likelihood of exposure to pregnant women, strong teratogens to which women are commonly exposed ... should contain teratogenicity warnings as well. The Agency does not agree that endrin should be characterized as a "weak" teratogen[7/]. It agrees, in principle, that many compounds should bear teratogenicity warnings and intends to enforce that priniciple when appropriate.

7/ Velsicol's characterization of endrin as a "weak" teratogen apparently derives from statements made by one of its consultants regarding the Chernoff study (Velsicol, Exh.30, p. 8 and SAP, October 26, 1978 p.51 and Velsicol, Exh.32). At the SAP meeting, Velsicol's consultant stated, "....there is some teratogenic potential, albeit a low level for this compound [endrin], but that potential occurs only at maternal toxic levels or very near to maternal toxic levels" (SAP, p. 51). The basis for this position has never been made clear. Previously, the consultant stated, "A single dose as high as 10 mg/kg produced no maternal toxicity and had no effect on intrauterine mortality or growth of the offspring. Two types of malformations ... were

(Footnote Continued)

7. Protective Clothing for Workers

The USDA commented, "We question the advisability of requiring protective clothing for all female workers. The teratogenicity risk, as defined, should apply only to female workers capable of bearing children." On the other hand, Velsicol states, "Protective clothing should be worn by men as well as women. This is because any hazards to applicators or field workers would be from acute exposure, not from a teratogenic hazard" (Velsicol, p.91).

Since the risk criterion for acute dermal toxicity for endrin had been rebutted by Velsicol, the Agency determined to only impose additional protective clothing requirements for female workers since they were imposed on the basis of a teratogenic risk. On that point, although it is true that only women who are capable of bearing children are at risk, the Agency believes that it is prudent to impose protective clothing requirements for all

7/ (Con't) significantly increased at the three highest single doses, 5.0,7.5, and 10.0 mg/kg" (Velsicol, Exh.30 pp.5-6). It appeared, on further discussion at the SAP meeting (SAP, pp.51-4), that the consultant's misperceptions of the data should have been rectified. The record is clear that frank terata were produced by single doses of endrin that were substantially below that which caused observable maternal toxicity to female hamsters. The argument that near-toxic levels were required to produce terata from single-dose exposure is not based on fact and any conclusion regarding endrin's "low potential" for teratogenicity based on that argument is spurious.

women involved in application of endrin since the vast majority of such female workers are likely to be of child-bearing age. Second, as an independent matter (and before the teratogenic risk came into focus), Velsicol proposed general improvements in labeling to protect against acute risks to all workers (Akesson, 1978). The Agency agrees that all workers could be protected more effectively against acute risks by improvements in protective clothing and equipment and registrants are encouraged to voluntarily apply such label improvements to men as well as women.

8. Warnings on Prophylactic Use

In its Notice of Determination, the Agency proposed the following language, "Prophylactic Use. Unnecessary use of this product can lead to resistance in pest populations and subsequent lack of efficacy." The Agency received several comments on this proposal.

The USDA commented, "We do not believe the statement on prophylactic use adds anything to the usefulness of the label information and should be deleted" (Bergland, 1978). The SAP report indicated that, "The Panel is concerned with the risks inherent with the prophylactic use of endrin and urges that the Agency reexamine the label statements regarding such use" (Fowler, 1978). Velsicol's comment was, "Velsicol proposed to prohibit prophylactic use of endrin.

The Agency's proposed label language, however, merely is in the form of a warning and is not emphatic enough deterrent against prophylactic use" (Velsicol, p.90).

Finally, Dr. Ross Byers (Byers, 1978) wrote:

> The statement, page 33 concerning "Prophylactic Use" is not based on fact. Resistance in vole populations is not the result of using Endrin when not needed! Where resistance develops is when partial control is achieved through low dosage applications and/or poor application technique. Partial control allows sufficient animals within the area to continue the reproduction of survivors in the presence of the toxicant. Pine vole populations were first found resistant to Endrin in the areas most seriously infested and where growers were using reduced rates per acre and/or using rather poor application techniques.

The comments of USDA and the SAP on prophylactic use are diametrically opposed and in neither case is the basis for the position fully articulated. The Agency can only respond by a fuller explanation of its position.

The Agency considered imposing a prohibition against prophylactic use (that is, use when economic infestations are not present), such as that encouraged by Velsicol, rather than a warning. The Agency decided against the prohibition because it believed such a restriction would be generally unenforceable. Unless substantial damage is visible, it is usually not possible to determine, after control measures have been applied, whether or not the

controlled populations had been at economic levels. In any event, the Agency believes that the educational aspect of the proposed label language accomplishes the Agency's primary objective in this respect, so that a prohibition per se is not necessary.

Dr. Byers' account is not necessarily at variance with the principles on which the Agency relies in its concerns about resistance. Dr. Byers indicates that repeated usage was necessary because of poor control and implicates the poor control as a critical factor in the development of resistance. While, historically, this may have been the case in Virginia, the reason for making frequent applications is not relevant to the principles of natural selection that lead to genetic resistance; selection should be even more rapid if repetitive control is highly effective. Dr. Byers' comment does highlight the importance of proper application methods and the proposed label changes regarding rates and equipment should help to prevent situations such as those described by Dr. Byers.

9. Enforcement

The EDF notes that pests other than those for which the Agency proposes to maintain registration may occur in small grains and orchards and asks, "How does the 1978 amendment (Section 2 (ee)), which allows use on a site

against pests not named on the label, affect these 'cancelled' uses?" (Hinkle, 1979). The Agency was cognizant of this problem and addressed it in accordance with Section 2 (ee) of FIFRA by requiring that the labeling specifically state that endrin may be used "only" for the pests specified on the label, after it was determined that the use of endrin against other pests would cause an unreasonable adverse effect on the environment. The Agency is aware that strict enforcement of label restrictions may be impossible but believes that, where its regulatory actions have been reasonable, an adequate level of compliance can be anticipated. Any substantial evidence that misuse has become a common practice would provide a basis for further regulatory action.

10. Grasshopper Control

The EDF strenously opposes the use of endrin to control grasshoppers, citing the existence of risks to fish, wildlife and livestock from the use of endrin on wheat and the availability of safer alternatives (Hinkle, 1979). Since this use of endrin was not fully analyzed in PD 2/3 because available information on both risks and benefits appeared to be inadequate, the Agency will continue to review any new evidence as it becomes available. If that review indicates that additional regulatory action is

desirable, the Agency will issue a supplement to PD 2/3 for review by the SAP, the USDA, the FWS, and the public. Concerned parties are requested to submit any additional information regarding the risks and benefits from the use of endrin to control grasshoppers as soon as possible.

When the Agency began its risk/benefit analysis, the only registration for endrin to control grasshoppers was for small grains in Montana. This old state registration is now pending as an application for federal registration for use in Montana. While PD 2/3 was in preparation, the Agency also received endrin registrations for special local needs in the states of Nebraska and Oklahoma, pursuant to Section 24(c) of FIFRA, to control grasshoppers both in winter wheat and as perimeter treatments in non-cropland (but not on rangeland). This latter site for the use of endrin to control grasshoppers will also be re-evaluated in the event that new data on the risks and benefits of that use become available. Currently endrin use for grasshopper control is restricted to the above three states.

D. Comments Relating to Procedural Matters

The Agency has received several comments with regard to the RPAR process and how, in the case of endrin, the Agency has administered the process. Since some of these comments reflect misunderstanding, misconstrue the record, or otherwise influence the public perception of Agency activities, the issues raised by these comments require some discussion and clarification.

1. Availability of the Agency's Rebuttal Analysis

Velsicol has stated that "the [RPAR] regulations require the Administrator to issue prior to initiation of a risk/ benefit analysis a notice of determination as to whether the cited risk presumptions have been rebutted. See 40 CFR 162.11(a)(5). In the case of the endrin RPAR, however, the Agency's rebuttal analysis was not made available to Velsicol until after the Agency's risk/benefit analysis had been completed." (Velsicol, pp.5-6, FN 1, emphasis in original).

Velsicol has misinterpreted the relevant provisions of the RPAR regulations. It is true that Section 162.11 (a)(5)(ii) states that "... if after review of the evidence submitted in rebuttal the Administrator determines that the applicant or registrant has not rebutted the presumption..., then he shall issue a notice in accordance with sections 3(c)(6), or 6(b)(1) of the Act..., as appropriate, for the use(s) of the pesticide subject to the presumption and not rebutted." However, Section 162.11 (a)(5)(iii) specifically provides that "in determining whether to issue a notice pursuant to section 3 (c)(6) or section 6 (b)(1) ... in accordance with paragraph (a)(5)(ii) of this section 162.11, the Administrator may, in his discretion, take into account staff recommendations resulting from preliminary analysis, if any, concerning the balancing

of risks against benefits." In other words, the regulations clearly contemplate that the Administrator may evaluate benefits, and the balancing of those benefits against risks, in determining whether or not to issue a notice of intent to cancel or deny registration in cases where the risk presumptions have not been rebutted. Contrary to Velsicol's assertions, nothing in those regulations or otherwise requires the Administrator to issue a separate document as to whether the risk presumptions have been rebutted, prior to initiating the risk/benefit analysis[8/].

2. Initiation and Evaluation of New Studies on Teratogenicity

Velsicol has portrayed a situation which does not correctly represent either the Agency's timing of, or motive for, initiation of additional teratology studies on endrin by its own scientists. First, Velsicol claims that because the Agency was "[a]pparently dissatified with IRDC's findings, in January, 1978, the Agency requested Dr. Chernoff of its Health Effects Research Laboratory to confirm the

8/ Velsicol also argues that the Agency's alleged refusal to disclose its rebuttal analysis prior to completion of its risk/benefit analysis "unnecessarily delayed Velsicol from developing further information on the Agency's remaining risk concerns." (Ibid). Even assuming that the regulations contemplate repeated opportunities for registrants to rebut presumptions of risk (by "developing further information" after it is determined that the presumption was not rebutted by the initial submission), the Agency does not believe that Velsicol was prejudiced in the circumstances of this case. In any event, the Agency accepted Velsicol's comments on PD 2/3 on January 5, 1979 - over two months after Velsicol received a copy of PD 2/3.

results of the Ottolenghi and IRDC studies." (Velsicol, p.35). As a matter of fact, however, HERL was requested to do a comparative study of single vs. multiple dosing of hamsters on August 15, 1977 -- well before even the draft results of the IRDC studies were forwarded to the Agency[9/].

More significantly, it is surprising that Velsicol would continue in its January 1979 submission to make the unfounded allegations concerning the timing of the internal request, particularly since in December 1978 it specifically acknowledged that the Agency's internal request was made in August 1977[10/]. The Agency does not believe that any valid purpose is served by what is at best careless presentation of the facts.

9/ However, Dr. Chernoff did not initiate the study itself until January 1978 because the project had not been assigned due to an internal misunderstanding at HERL.

10/ See Velsicol Exhibit 28, which is a letter from Louis G. Nickell, Vice-President of Velsicol, to H. Wade Fowler, Director of SAP, dated December 7, 1978. On page 1, Mr. Nickell states that the "Chernoff study 5/ was requested by Dr. Kyle Barbehenn 6/...". Reference 6 to the letter reads: "6. Barbehenn, K.R., SPRD, EPA. August 15, 1977. Request for Assistance: Teratogenicity of Endrin. Memorandum to John Knelson, Environmental Research Center, Health Effects Research Laboratory, EPA, Research Triangle Park, North Carolina".

Second, the Agency's inquiry into the validity of the IRDC studies did not occur until Dr. Chernoff attempted to replicate the IRDC studies and was unsuccessful in solubilizing endrin in methocel, the test vehicle used by IRDC in alleged conformity with the protocols which had previously been submitted to the Agency. As Velsicol is well aware, those protocols specifically stated (Velsicol, Exh. 37): "Vehicle will be selected that will solubilize the Endrin, and will not potentiate teratogenic or fetotoxic effects" (Emphasis Added).

When Dr. Chernoff could not solubilize endrin in methocel, it was discovered that the final IRDC reports (Velsicol, Exh. 38,39) indicated that "endrin was suspended in a 0.5% aqueous Methocel^{R} solution at varying concentrations ... " (emphasis added). When the Agency demanded an explanation of this apparent deviation from the protocols, IRDC responded (Velsicol, Exh. 40): "With regard to the protocols, we have interpreted the word 'solubilize' to mean to make more soluble rather than to prepare a true chemical solution. By the use of Methocel as a vehicle, some Endrin was solubilized and the remainder suspended, resulting in fulfillment of the protocol requirement of solubilizing Endrin."

Whether or not, as a scientific matter, this unilateral interpretation in any way affected the validity of the results of the IRDC studies, it seriously undermines

Velsicol's implications that the Agency capriciously raised after-the-fact questions about the IRDC protocols "despite the efforts of Velsicol in advance of the IRDC studies to ensure that the protocols were acceptable to the Agency and despite Velsicol's belief that the Agency had approved the protocols in every respect." (Velsicol, p.36).

Finally, Velsicol asserts that it did not receive Chernoff's final report until September 6, 1978, whereupon it arranged to have two outside teratologists (Drs. Steffek and Wilson) review the studies and data and prepare expert analyses (Velsicol, p.7, FN2). However, Velsicol elsewhere acknowledges that it received a draft copy of the Chernoff study in July, 1978 (Velsicol, p.36); and, in fact, Dr. Steffek visited Dr. Chernoff shortly thereafter (on Velsicol's behalf) to discuss his draft paper.

3. Use of Relevant Information on Risk Assessment

Velsicol has alleged that the Agency "apparently was unable to take into account ... in Position Document 2/3 significant risk information on teratogenicity and other matters which had been developed at the Agency's request" (Velsicol, pp.7 and 17). Although the Agency extended the opportunity to Velsicol to comment upon the teratogenicity issue prior to the issuance of PD 2/3, the matters referred to were certainly not developed "at the Agency's request."

Moreover, while the Agency indicated a willingness to consider any new information for its potential impact on the pending decision, preliminary reviews by the Agency indicated that none of Velsicol's last minute submissions contained any information that required any change in the Agency's position. And, as indicated in this PD 4, the Agency has reviewed and commented on all relevant information supplied by Velsicol before making this final decision, so that the Agency's review process has not resulted in any prejudice to Velsicol.

4. Development of State Programs for Use on Cotton

Representatives of the states of Alabama, Arkansas and Mississippi requested the Agency to defer the final decision on the use of endrin on cotton until the States can develop programs that would substantially alter the risk/benefit picture (Lane, 1979; Lincoln, 1979a; Coley, 1979). The Agency responded by indicating that it wishes to encourage the development of such programs in general but, in the absence of new information, the Agency had no basis for deferring a decision already overdue (Johnson, 1979a). It also indicated that should new information on risk/benefit relationships be developed, including the institution of state programs which would establish appropriate controls to enhance the risk/ benefit ratio for the use of endrin on

cotton, it would then be appropriate for the Agency to reconsider the registration for the use of endrin on cotton in areas east of I-35.

The state of Arkansas then proposed that the State would establish a new category for certain restricted use pesticides such as endrin, in effect making them available for use only under emergency conditions to be identified by extension personnel (Martin, 1979). The Agency responded that many specific details of such a program would have to be developed for further consideration, that a revised risk/benefit analysis would be necessary, and that any new decisions proposed by the Agency would require reconsultation with the FWS and public review (Johnson, 1979b). Thus, the Agency still has no basis for deferring its decision but will reconsider it whenever it is justified by the availability of new information.

III. Conclusions

After considering the comments received from the USDA, the SAP, the USDI, Velsicol and other concerned parties, the Agency has decided to make the following revisions to the Notice of Determination:

A. Registration for Use on Cotton

1. Warning to Female Workers. "Excessive exposure to endrin may cause birth defects" will be amended to read, "Excessive exposure to endrin during pregnancy may cause birth defects."

2. Aerial Application. "Do not release this material at greater than 19 feet height above the crop" will be amended to read "...10 feet height above the crop."

3. Application Restrictions. "Do not use this product within 150 yards of human habitation "will be amended to read "Do not apply this product within 1/8 mile of human habitation."

"Do not use this product within 1/4 mile of streams, lakes, or ponds. Application may be made within 1/4 mile of ponds owned by the user, but application within 200 yards of such ponds may result in fish kill" will be amended to read, "Do not apply this product by air within 1/4 mile or by ground within 1/8 mile of lakes, ponds, or streams. Application may be made at distances closer to ponds owned by the user but such application may result in excessive contamination and fish kills."

4. "Procedures to be Followed if Fish Kills Occur. In case of fish kills, fish must be collected promptly and disposed of by burial. At ponds, post signs stating: Contaminated: No Fishing. Signs must remain for one year after fish kill has occurred" will be amended to read, "Procedures to be Followed if Fish Kills Occur or if Ponds are Contaminated. In case of fish kills, fish must be

collected promptly and disposed of by burial. Ponds in which fish kills have occurred, and user-owned ponds exposed to endrin by application at distances closer than otherwise prohibited, must be posted with signs stating: 'Contaminated: No Fishing.' Signs must remain for one year after a fish kill has occurred or for six months after lesser contamination unless laboratory analysis shows endrin residues in the edible portion of fish to be less than 0.3 parts per million (ppm)."

5. Add: "For use in areas west of Interstate Highway #35 only".

B. Registration for Use on Small Grains

Amendments 1, 2, 3, and 4 for cotton (A, above) are applicable for small grains.

C. Registration for Use in Apple Orchards

1. Amend the "Warning to Female Workers" as above.

2. Pests for Which this Product May be Applied, "This product may be applied to control the following pest only: pine vole; western meadow vole" will be amended to read, "This product may be applied to control the following pests only: Eastern United States-Pine Voles (Microtus pinetorum); Western United States-Meadow Voles (Microtus species)".

3. Equipment. Add, "Apply by ground equipment only."

4. Procedures to be Followed If Fish Kills Occur

"In case of fish kills, fish must be collected promptly and disposed of by burial. At ponds, post signs stating: 'Contaminated: No Fishing'. Signs must remain for one year after fish kill has occurred." will be amended to read "In case of fish kills, fish must be collected promptly and disposed of by burial. Ponds in which fish kills have occurred must be posted with signs stating: 'Contaminated: No Fishing'. Signs must remain for one year after a fish kill has occurred unless laboratory analysis shows endrin residues in the edible portion of fish to be less than 0.3 parts per million (ppm)."

D. Registrations for Use on Sugarcane

Amend the "Warning to Female Workers" as above.

E. Registration for Treatment of Conifer Seed

Application Restrictions. "Do not apply when large numbers of migratory birds are expected " will be amended to read: "Do not sow treated seed when large numbers of migratory birds are expected."

F. Registrations for Use as Tree Paint

Amend the "Warning to Female Workers" as above.

G. Registration of Use on Alfalfa and Clover Seed Crops

Amendments 1, 2, 3, and 4 for cotton (A, above) are applicable to alfalfa and clover seed crops.

H. Registration for Use in Enclosed Bird Perch Treatments

Amend the "Warning to Female Workers" as above.

Except for the above amendments, all provisions of the Notice of Determination will be adopted as the final decision on the registration and continued registration of pesticide products containing endrin.

BIBLIOGRAPHY

Akesson, Norman B. 1977. The Technical Advisory Committee on Label Restrictions for Endrin-Methyl Parathion 1.6 EC and Endrin 1.6 EC. Report from the committee's meeting in Denver, Colorado, December 8-9, 1977.

Akesson, Norman B. 1978. Letter from Agricultural Engineering Department, University of California, Davis, California to Lawrence Ebner, Sellers, Conner and Cuneo, Attorneys and Counselors, Washington, D.C., defining water bodies and streams for endrin use and limitations. August 25, 1978.

Alley, E. G., B. R. Layton, and J. P. Minyard, Jr. 1974. Photoreduction of Mirex in aliphatic amines. J. Ag. Food Chem. 22 (4), 727-9.

Anderson, Elizabeth L. 1978a. Memo from Executive Director, CAG, EPA, to H. Wade Fowler, Executive Secretary, FIFRA Science Advisory Panel (SAP), transmitting a response to Melvin Reuber's critique of the endrin carcinogenicity review. December 7, 1978.

Anderson, Elizabeth L. 1978b. Memo from Executive Director, CAG, EPA, to H. Wade Fowler, Executive Secretary, FIFRA SAP, transmitting additional comments to Melvin Reuber's critique of CAG's endrin review. December 13, 1978.

Baker, R. D., and H. G. Applegate. 1974. Effect of ultraviolet radiation on the persistence of pesticides. Texas J. Sci. 25 (1-4), 53-9.

Bergland, Bob. 1978. Letter from Secretary, U.S. Department of Agriculture, to Douglas Costle, Administrator, U.S. Environmental Protection Agency, responding to EPA's notice of determination concluding the endrin RPAR. November 22, 1978.

Blalock, T. C. 1978. Letter from Associate Dean, North Carolina State University School of Agriculture and Life Sciences, to Technical Services Division, OPP, EPA, commenting on proposed actions on endrin. November 14, 1978.

Brooks, Leroy. 1978. Letter fro. Extension Specialist, Kansas Cooperative Extension Service, to Dr. Paul W. Bergman, USDA, concerning endrin use on small grains and endrin use restrictions. November 20, 1978.

Crockett, A. B., G. B. Wiersma, H. Tai, and W. Mitchell. 1975. Pesticide and mercury residues in commercially grown catfish. Pest. Monit. J. 8 (4), 235-40.

EPA. 1977. Preliminary Benefit Analysis of Endrin. Economic Analysis Branch, (EAB), CED, OPP, Washington, D.C.

EPA. 1978. Endrin Position Document 2/3. SPRD, OPP, USEPA, October 20, 1978.

Fowler, H. Wade, Jr. 1978. Memorandum from Executive Secretary, FIFRA SAP, to Edwin Johnson, Deputy Assistant Administrator, OPP, EPA, transmitting the SAP's findings on endrin. December 21, 1978.

Greenwalt, Lynn A. 1978a. Director, Fish and Wildlife Service, U.S. Department of the Interior, to Douglas Costle, Administrator, EPA, concerning effects of endrin on populations of endangered species. June 8, 1978.

Greenwalt, Lynn A. 1978b. Letter from Director, Fish and Wildlife Service, U.S. Department of the Interior, to Douglas M. Costle, Administrator, EPA, amending biological opinion of June 8, 1978. December 14, 1978.

Greenwalt, Lynn A. 1979. Letter from Director, Fish and Wildlife Service, U.S. Department of the Interior, to Douglas Costle, Administrator, EPA, revising biological opinion of December 14, 1978. March 1, 1979.

Hinkle, Maureen. 1979. Letter from Pesticides Monitor, Environmental Defense Fund, to U.S. Environmental Protection Agency, concerning the preliminary determination of the endrin RPAR. February 15, 1979.

Johnson, Edwin L. 1979a. Letter from Deputy Assistant Administrator, OPP, EPA, to McMillan Lane, Commissioner, Alabama State Department of Agriculture and Industries, concerning state programs to affect endrin risk/benefit balancing. March 6, 1979.

Johnson, Edwin L. 1979b. Letter from Deputy Assistant Administrator, OPP, EPA, to Mr. Wallace Martin, Arkansas State Plant Board, concerning a proposed state program for special restricted-use pesticides. April 16, 1979.

Lane, McMillan. 1979. Letter from Commissioner, Alabama State Department of Agriculture and Industries, to Douglas Costle, Administrator, EPA, concerning the need for endrin for use on Alabama cotton. January 23, 1979.

Bushong, Clayton. 1978. Memo to Kyle Barbehenn, Project Manager, SPRD, OPP, EPA, concerning "Opinions on Endrin" Letter with Four Separate Risk Analyses Attached. June 28, 1978.

Byers, Ross E. 1978. Letter from Assoicate Professor of Horticulture, Virginia Polytechnic Institute and State University, to Dr. James P. Barnett, Endrin Impact Assessment Team Leader, USDA, concerning endrin for vole control. November 14, 1978.

Castro, T. F., and T. Yoshida. 1971. Degradation of organochlorine insecticides in flooded soils in the Philippines. J. Ag. Food. Chem. 19 (6), 1168-70.

Chernoff, Neil, Robert J. Kavlock, and L. Earl Gray, Jr. 1978a. Endrin-induced perinatal toxicity studies in the hamster with a review of the pertinent literature. Health Effects Research Laboratory, Experimental Biology Division, EPA. Research Triangle Park, North Carolina (Unpublished) August 25, 1978.

Chernoff, Neil, Robert J. Kavlock and L. Earl Gray, Jr. 1978b. Memo to Kyle Barbehenn, SPRD, OPP, EPA, concerning review of statements by Drs. A. J. Steffek and J. G. Wilson about endrin teratology studies. November 13, 1978.

Coley, Jack. 1979. Letter from Mississippi State Entomologist, to Douglas Costle, Administrator, EPA, concerning possible state restrictions to allow some uses of endrin. January 24, 1979.

Coppage, David. 1978. Memo from Aquatic Biologist, EEB, HED, OPP, EPA, to Kyle Barbehenn, Project Manager, SPRD, OPP, EPA, concerning theoretical movement of endrin from soil into water and the effect of this movement on non-target organisms. December 13, 1978.

Coppock, Stanley. 1976. Letter from Extension Entomologist, Cooperative Extension Service, Oklahoma State University, Stillwater, Oklahoma, to Edwin L. Johnson, OPP, EPA. December 29, 1976.

Coppock, Stanley, and Terry Pitts. Undated. Grasshoppers and insecticides for their control. Oklahoma State University Extension Service. (Unpublished).

Lincoln, Charles. 1978. Letter from member, Arkansas State Plant Board, to Edwin L. Johnson, Deputy Assistant Administrator, OPP, EPA, concerning presumptions supposedly rebutted at the SAP meeting. March 15, 1979.

Lincoln, Charles. 1979. Letter from member, Arkansas State Plant Board, to Douglas Costle, Administrator, EPA, concerning possible state restrictions to preserve some endrin uses. January 19, 1979.

Leonard, R. A., G. W. Bailey, and R.R. Swank, Jr. 1976. Transport, detoxification, fate, and effects of pesticides in soil and water environments, in Land Applications of Waste Materials, published by Soil Conservation Society of America, Ankeny, Iowa.

Martin, Wallace. 1979. Memo from Chairman, Arkansas State Plant Board, to EPA, concerning state restriction of pesticide uses. March 14, 1979.

Matsumura, F., V. G. Khanzilkar, K. C. Patil, and G. M. Boush. 1971. Metabolism of endrin by certain soil micro-organisms. J. Agric. Food Chem. 19:27-31.

Moubry, R. J., J. M. Helm, and G. R. Myrdal. 1968. Chlorinated pesticide residues in an aquatic environment located adjacent to a commercial orchard. Pest. Monit. J. 1 (4), 27-9.

Mount, D.I. and G.J. Putnicki. 1966. Summary report of 1963 Mississippi fish kill. In: Trans. 31st N. Amer. Wildlife Conf. 177-184. Wildl. Manag. Inst., Washington, D.C.

Pionke, H. B., and G. Chesters. 1973. Pesticide-sediment-water interactions. J. Environ. Qual. 2 (1), 29-45.

Reuber, Melvin D. 1978a. Critique of the carcinogenicity studies on endrin in animals. November 2, 1978.

Reuber, Melvin D. 1978b. Carcinogenicity of endrin. Frederick Cancer Research Center, Frederick, M.D. (Unpublished) November 28, 1978.

Science Advisory Panel. 1978a. Transcript of Proceedings of FIFRA SAP Meeting, October 26, 1978, in Arlington, Virginia. Reported by Acme Reporting Company, Washington, D.C.

Science Advisory Panel. 1978b. Transcript of Proceedings of FIFRA SAP Meeting, December 14-15, 1978, in Arlington, Virginia. Reported by Acme Reporting Company, Washington, D.C.

Seabolt, Buford. 1978. Memo to Dr. Ren Macek concerning endrin residues from NPMP (fish). September 18, 1978.

Severn, David J. 1978. Memo from Chemist, EFB, HED, OPP, EPA, to Kyle Barbehenn, Project Manager, SPRD, OPP, EPA, concerning Dr. V. H. Freed's statement to the SAP on endrin runoff. November 9, 1978.

Smith, C. N., R. A. Leonard, G. W. Langdale, and G. W. Bailey. 1978. Transport of agricultural chemicals from small upland piedmont watersheds.

Sparr, B. I., W. G. Appleby, D. M. DeVries, J. V. Osmun, J. M. McBride, and G. L. Foster. 1966. Insecticide residue in waterways from agricultural use, in Organic Pesticides in the Environment, American Chemical Society Washington, D.C.

Stickel, William H., William L. Reichel; Donald L. Hughes. Undated. Endrin in birds: lethal residues and secondary poisoning. Patuxent Wildlife Research Center, U.S. Fish and Wildlife Service, Laurel, M.D. (Unpublished).

USDA. 1968. Monitoring for chlorinated hydrocarbon insecticide residues in soybeans---1966. Pesticide Monit. J. 2 (1), 58-67.

USDA/EPA. 1975. Control of Water Pollution from Cropland. Vol. I. Report No. ARS-H-5-1.

USDA/EPA. 1976. Control of Water Pollution from Cropland, Vol II. Report No. ARS-H-5-2.

USDA/State Assessment Team on Endrin. Pesticide Impact Assessment: Endrin. November 4, 1976.

Velsicol Chemical Corporation. 1979. Response of registrant Velsicol Chemical Corporation to the preliminary determination concerning the rebuttable presumption against registration and continued registration of pesticide products containing endrin. 91 pp + 61 Exhibits. January 5, 1979.

Willis, G. H., L. L. McDowell, J. F. Parr, and C. E. Murphree. 1976. Pesticide concentrations and yields in runoff and sediment from a Mississippi Delta watershed. Proc. Fed. Inter-Agency Sediment. Conf., 3rd.